

WHAT IS CLAIMED IS:

1. An ion implantation method for implanting hydrogen ions to a predetermined depth of a semiconductor substrate, comprising steps of:

5 introducing hydrogen gas into a chamber where an inner pressure is reduced and a predetermined magnetic field is formed;

generating plasma by introducing a microwave into the magnetic field;

10 extracting hydrogen ion beams containing hydrogen molecule ions from the plasma; and

irradiating the hydrogen molecule ions onto the semiconductor substrate.

15 2. The ion implantation method according to claim 1, wherein a frequency of the microwave and an intensity of the magnetic field satisfy conditions represented by any of following expressions:

$$\omega > \frac{eB}{2\pi m_e}$$

$$\omega < \frac{eB}{2\pi m_e}$$

20 where ω is the frequency of the microwave, m_e is a mass of electrons, e is a charge of the electrons, and B is the intensity of the magnetic field.

3. The ion implantation method according to claim 1, wherein a mean residential time of hydrogen molecules from the

introduction of the hydrogen gas into a generation region of the plasma to the extraction of the hydrogen ion beams ranges from 5×10^{-4} to 5×10^{-3} seconds.

4. The ion implantation method according to claim 1, wherein one including an insulating layer on a Si substrate is used as the semiconductor substrate, and the hydrogen molecule ions are implanted to a predetermined depth of the Si substrate by irradiating the hydrogen molecule ions from a side of the insulating layer.

5 10 The ion implantation method according to claims 1, wherein one including a SiO_2 layer on the Si substrate is used as the semiconductor substrate, and the hydrogen molecule ions are implanted to a predetermined depth of the Si substrate by irradiating the hydrogen molecule ions from a side of the SiO_2 layer.

15 6. A method for manufacturing an SOI wafer, comprising:

an ion implantation step of forming a hydrogen ion implanted layer to a predetermined depth of a first wafer having an insulating layer on one surface of a Si substrate by the 20 ion implantation method according to claim 1;

a layering step of obtaining a layered body by layering a second wafer formed of a Si substrate on the insulating layer of the first wafer having been subjected to the ion implantation step; and

25 a partition step of partitioning the layered body at the hydrogen ion implanted layer.

7. The method for manufacturing an SOI wafer according to claim 6, wherein the insulating layer is a SiO₂ layer.

8. A method for manufacturing a SOI wafer, comprising:

5 an ion implantation step of forming a hydrogen ion implanted layer to a predetermined depth of a third wafer formed of a Si substrate by the ion implantation method according to claim 1;

10 a layering step of obtaining a layered body by layering an insulating layer and a second wafer formed of a Si substrate on a predetermined surface of the third wafer having been subjected to the ion implantation step; and

a partition step of partitioning the layered body at the hydrogen ion implanted layer.

15 9. The method for manufacturing an SOI wafer according to claim 8, wherein the insulating layer is a SiO₂ layer.